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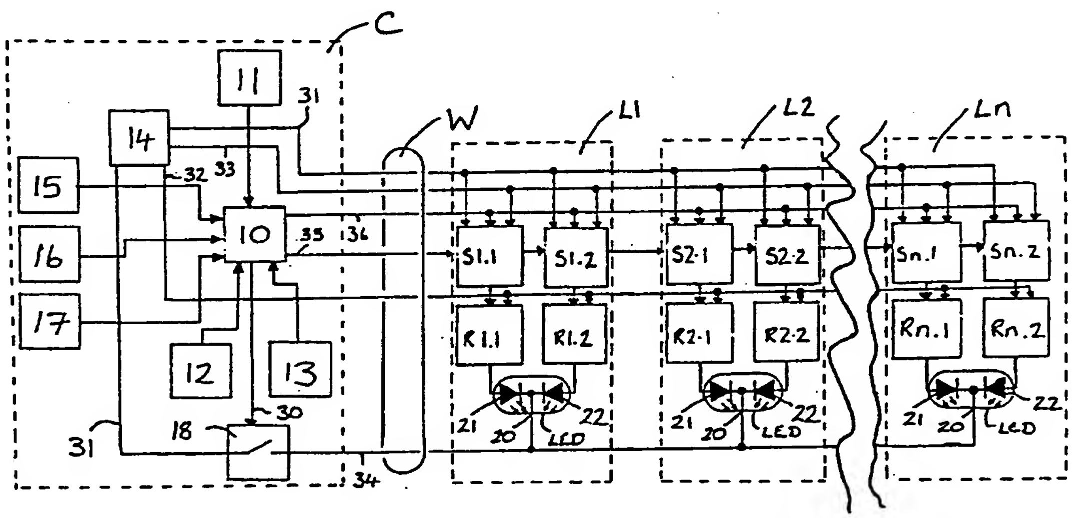
(54) **Lighting control system**

(57) A lighting controller comprises a series of data storage elements S1.1 – Sn.2 for controlling light sources LED connected to each element. The data storage elements S1.1 – Sn.2 are connected in series on a data wire 35 to a microprocessor 10 which outputs a series of data bits to control the light sources. By advancing the data bits along the data wire 35 through successive storage elements S1.1 – Sn.2, the lighting pattern can be changed.



The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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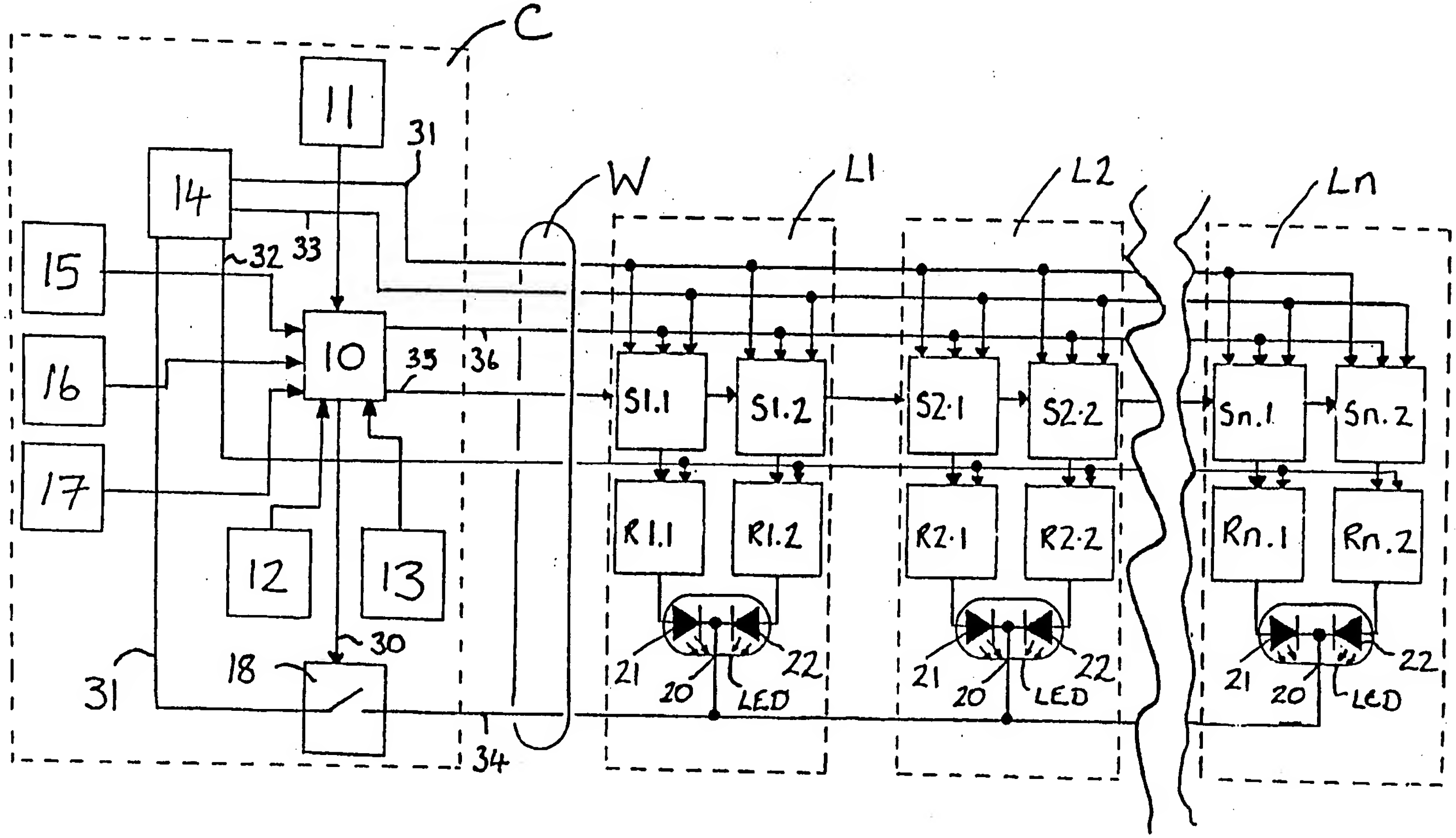
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S1.2
S2·1
S2·2
Sn.1
Sn.2
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LED

Lighting Control System

This invention relates to a lighting control system and more particularly but not solely to a control system for Christmas tree lights.

Christmas tree lights typically comprise a plurality of low voltage filament lamps connected in series across the mains. Each lamp may be coated with a coloured laquer of the same or different colour from adjacent lamps to emit a random or uniform pattern of coloured light. This pattern can only be varied by changing the lamp colour and has the disadvantage that if one lamp becomes open circuit the other lamps will extinguish.

Flashing or pattern changing lights are known which use electronically controlled switches to make or break the mains supply to one or more series of low voltage filament lamps in a set sequence. This system requires the use of many lamps and a large amount of wiring which is both expensive and unsightly.

Individually controllable lights are available that have one supply wire to each lamp and a common return wire, resulting in n + 1 wires required to control n lights. The lights at the end of the chain will be dimmer than those at the start due to power losses caused by the resistance of the long lengths of wire.

We have now devised a lighting control system which has individually controllable lights and which does not require a large number of control wires.

In accordance with this invention, there is provided a lighting control system comprising a plurality of data storage elements for controlling respective light sources according to their data content, the data storage elements being connected in series along a data wire, and a control unit for generating a series of data bits and for advancing the data bits along the series of storage elements in serial manner, the data

bits being advanced in groups of steps, which groups occur at predetermined intervals of time.

The number of steps in each group may be sufficient to advance a data bit or bits from the control unit to the last storage element in the series. Preferably each storage element holds one bit of information, which determines whether the respective light source is illuminated or extinguished. Preferably the pattern of data bits (or data word) differs for successive cycles (i.e. group of steps), and the time intervals between successive cycles may vary.

Preferably a microprocessor accesses stored patterns of data bits (or data words), and different ones of these are output on the different cycles. Preferably manual controls are provided for selecting any of the different patterns of data bits (data words) stored and for defining the time intervals between the successive cycles.

Preferably the light sources are extinguished as the data bits are advanced along the series of storage elements. Either the data bits are advanced at a rate greater than the response time of the light sources, or a supply line to the light sources may be interrupted during the bit-advancing cycle.

Preferably several storage elements and alternate coloured light sources are grouped together so that one or more of the light sources can be illuminated to form a more complex colour.

An embodiment of this invention will now be described by way of example only and with reference to the accompanying drawing, the single Figure of which is a block diagram of a lighting control system in accordance with this invention.

Referring to the drawing, there is shown a block diagram of a lighting control system comprising a control unit C to which a plurality of light units L1, L2, ... Ln are connected via a cable W. The control unit comprises a microprocessor 10 connected to a pattern and program store 11. Optionally a

read/write store 15, display 16, and communications link 17 may also be connected to the microprocessor 10 and two external switches 12, 13 are provided which give direct user control of the microprocessor 10. A blanking control wire 30 controls a switch 18 that makes or breaks the OV supply or ground return connection to light emitters LED in the respective light units L1 - Ln. A power supply unit 14 has +10V, +5V and OV outputs connected to wires 32, 33, 31 of the cable W, which also includes a ground return wire 34 connected to switch 18 and data and clock wires 35, 36 which are output from the microprocessor 10. The light units L1, L2, Ln are situated at predetermined intervals along the cable W.

Light unit L1 comprises a tri-colour light emitter LED which comprises red and green light emitting diodes 21, 22 connected together by their cathodes to form a single cathode wire 20 connected to the ground return wire 34. The diodes 21, 22 have their anodes connected to respective storage elements S1.1, S1.2 via regulator/buffer circuits R1.1 and R1.2. The storage elements S1.1, S1.2 are wired in parallel to the 5V, OV, and clock wires 33, 31, 36 of the cable W, and the regulator/buffer circuits R1.1, R1.2 are similarly connected to the 10V wire 32. The data wire 35 from the microprocessor 10 feeds the first storage element S1.1, the output of which feeds the second storage element S1.2. The output of this element S1.2 likewise feeds the first storage element S2.1 of the next light unit L2 on the cable W, and so on. All of the light units are identical in construction to light unit L1, and are connected in parallel to the wires of the cable W, with the exception of the data wire 35 which is connected in the above described manner through each storage element S in series. The system may include any number of the light units L1 - Ln.

In use the desired lighting pattern, and the rate at which the pattern changes may be selected using the rotary switches 12, 13. The microprocessor monitors which pattern sequence is required and calls up a predefined bit pattern

stored in the read-only memory 11. If there are 40 light units L on the cable W, there will therefore be 80 storage elements S each capable of storing one bit. The pre-defined bit pattern is clocked at high-speed in serial fashion along the data line 35 through each storage element S in blocks of 80 bits. The lighting pattern is decoded once the clock has stopped and the microprocessor 10 has closed the switch 13 to connect the ground return to the cathodes 20 of the light emitting diodes. The speed at which the pattern changes depends upon the time interval between the high speed bursts of clock pulse.

The storage elements each comprise a JK flip-flop and change state on trailing clock pulse edges. The outputs of the storage elements are used to drive the respective voltage regulator and buffers R to illuminate the respective light emitting diodes. A 10V supply wire 32 is connected to the voltage regulator and buffers R and supplies the drive current to each light emitting diode. The separate voltage supplies to the storage elements and light emitting diodes ensure a constant brightness along the cable W.

Each light emitter LED can be set at either RED, GREEN, RED + GREEN (YELLOW) or OFF depending on the contents of the two associated storage elements.
The blanking control line 30 may be used to extinguish the light emitting diodes whilst clock pulses are applied to prevent flicker as the data ripples through the storage elements S,

However, the data may ripple through at a speed greater than the response time of each light unit L in which case a blanking switch 18 may not be required.

Whilst the basic lighting control system described utilises a pre-programmed repertoir of lighting patterns, the addition of a read/write memory 15, keypad, and display 16 would allow for a user defined pattern to be created. Alternatively created patterns could be down loaded from a computer using the optional communications link 17.

The substitution of high powered filament lamps

and suitable power switching devices instead of light-emitting diodes would allow the system to be used for spotlight control e.g. for stage lighting. By grouping suitable different coloured lights and their storage elements together any colour light can be made to appear.

In a further embodiment the light sources on the cable W may be made to glow at varying brightnesses by sending a pattern data down the data wire instantaneously after the previous pattern data and so on. By accordingly altering an individual light units ON/OFF sequence at each data update any shade of brightness may be selected.

CLAIMS

(1) A lighting control system comprising a plurality of data storage elements for controlling respective light sources according to their data content, the data storage elements being connected in series along a data wire, and a control unit for generating a series of data bits and for advancing the data bits along the series of storage elements in serial manner, the data bits being advanced in groups of steps, which group occur at predetermined intervals of time.

(2) A lighting control system according to claim 1, in which the number of steps in each group is sufficient to advance data bits from the control unit to the last storage element in the series.

(3) A lighting control system according to claims 1 or 2, in which each storage element holds one bit of information, which determines whether the respective light source is illuminated or extinguished.

(4) A lighting control system according to any preceding claim, in which the pattern of data bits differs from successive cycles (i.e. group of steps).

(5) A lighting control system according to any preceding claim, in which the time interval between successive cycles (group of steps) varies.

(6) A lighting control system according to any preceding claim in which the light sources are extinguished as the data bits are advanced along the series of storage elements.

(7) A lighting control system according to claim 6, in which the data bits are advanced at a rate greater than the

response time of the light sources.

(8) A lighting control system according to claim 6, in which a voltage supply line to the light sources is interrupted during the bit-advancing cycle.

(9) A lighting control system according to any preceding claim, in which a plurality of storage elements and alternate coloured light sources are grouped together so that one or more of the light sources can be illuminated to form a more complex colour.

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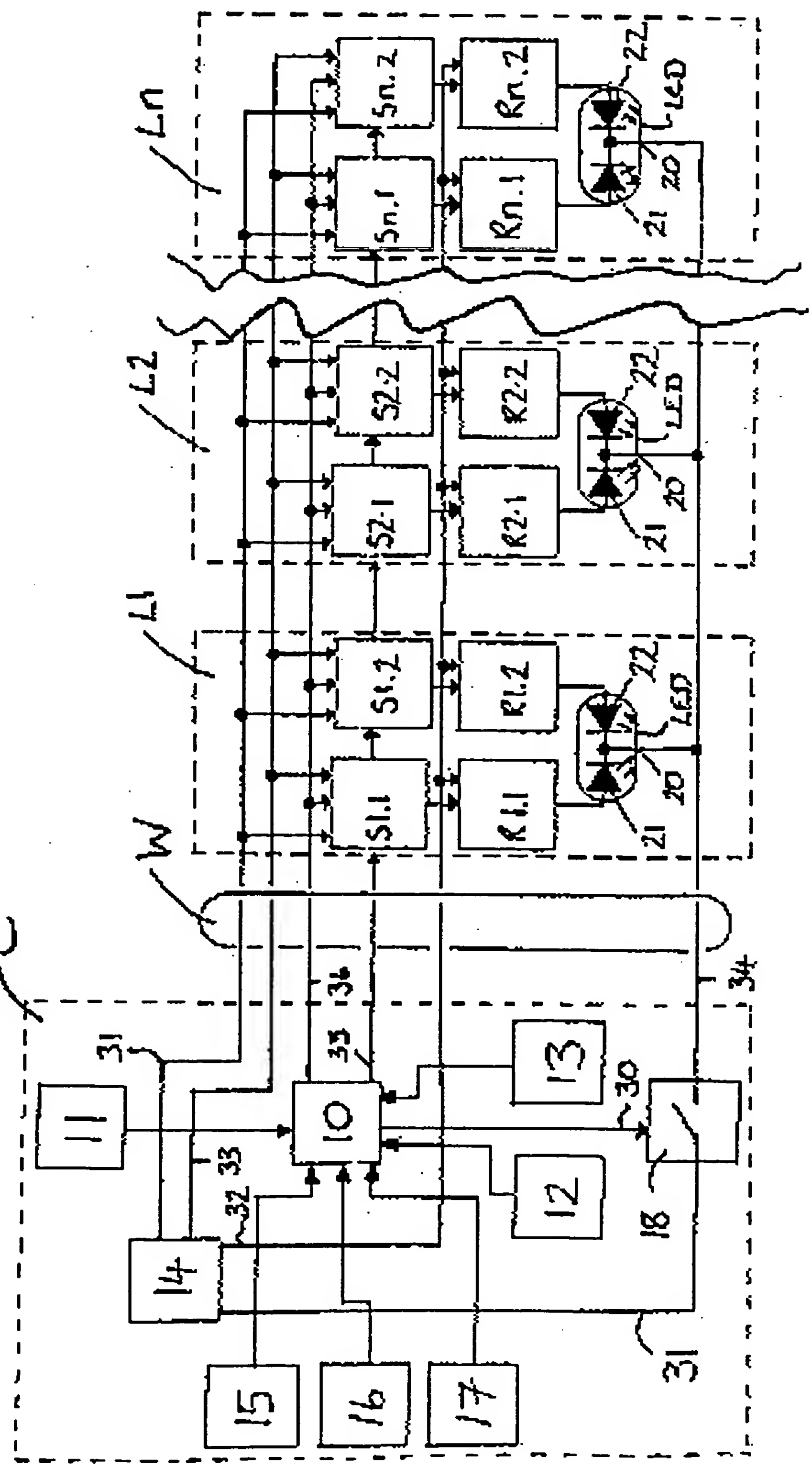

C
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L1
L2
Ln
S1.1
S1.2
S2.1
S2.2
Sn.1
Sn.2
R1.1
R1.2
R2.1
R2.2
Rn.1
Rn.2
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